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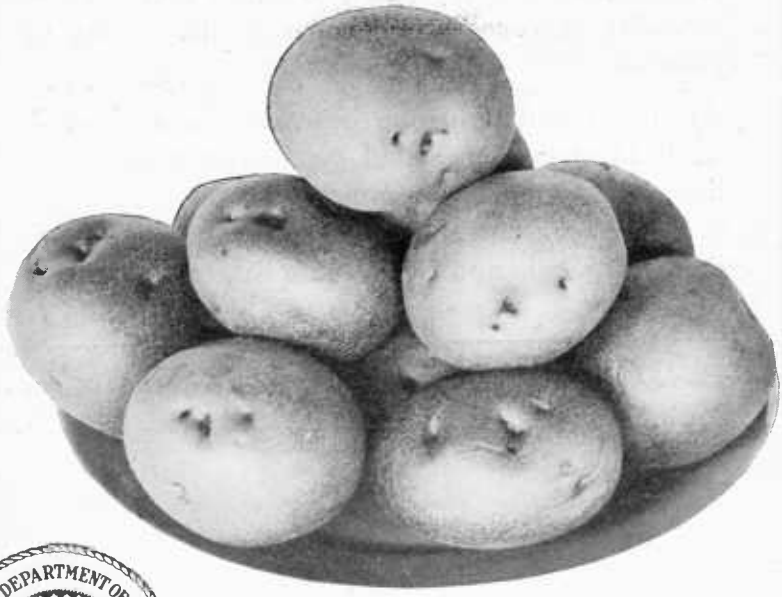
POTATO CULTURE UNDER IRRIGATION



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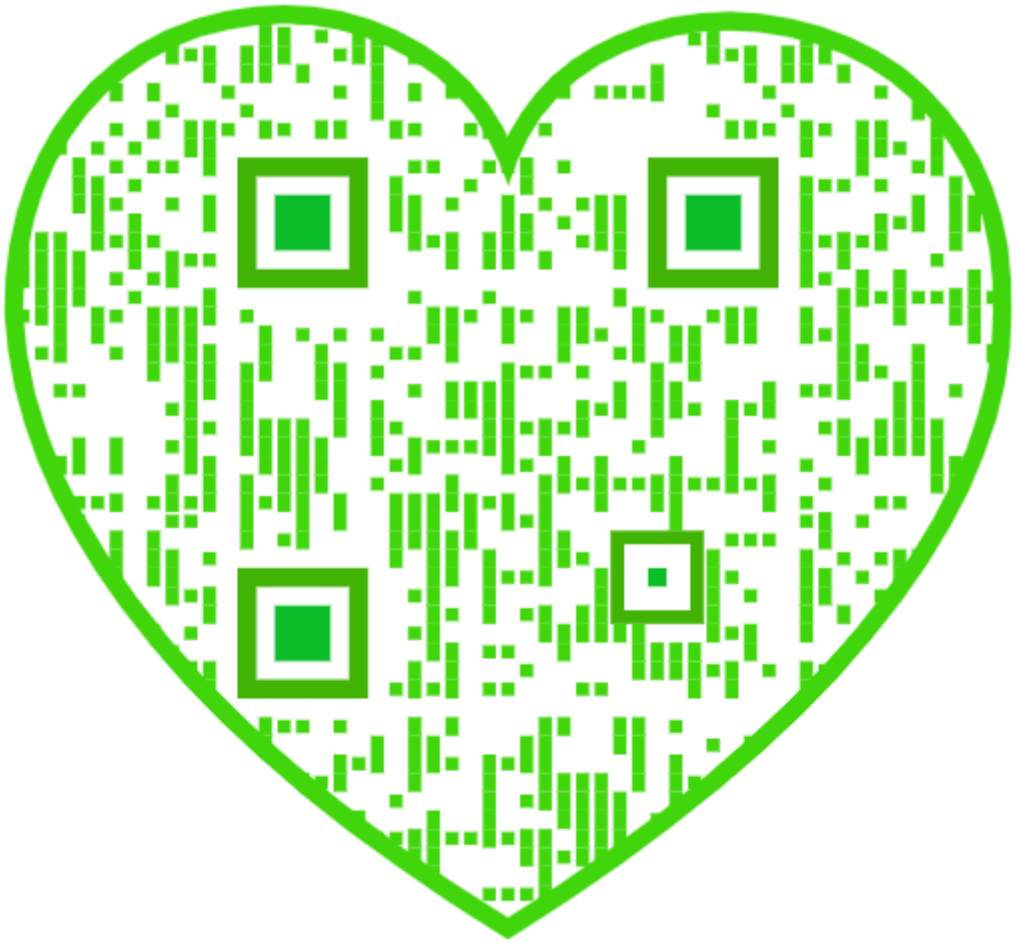

THE RAPID DEVELOPMENT of irrigation projects in the West and the well-recognized value of the potato both as a money crop and as a rotation crop have produced an ever-increasing demand for information as to the best cultural practices to adopt in the growing of potatoes under irrigation.

The information contained in this bulletin applies more specifically to the irrigated sections of Arizona, California, Colorado, Idaho, Montana, Nebraska, Nevada, New Mexico, South Dakota, Oregon, Utah, Washington, and Wyoming, in which more or less extensive acreages are devoted to the raising of potatoes.

Cultural and irrigation practices are not necessarily identical throughout the several States mentioned. A striking illustration of this is to be noted in connection with the tule, or peat, delta lands of the San Joaquin and Sacramento Rivers.

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POTATO CULTURE UNDER IRRIGATION.

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EXTENT OF THE INDUSTRY.

WITH THE INCREASING settlement on irrigation projects in the West there has come a more and more insistent demand for information as to the best methods of growing potatoes under irrigation. This publication is intended to supersede Farmers' Bulletin 386, which is confined almost entirely to potato production in Colorado and is not sufficiently inclusive to meet the present requirements.

The production of potatoes under irrigation is very largely confined to States or portions of States lying to the west of the Missouri River. The States to which the information contained in this bulletin more specifically applies are Arizona, California, Colorado, Idaho, Montana, Nebraska, Nevada, New Mexico, South Dakota, Oregon, Utah, Washington, and Wyoming. Other States in which irrigation is practiced in some localities in the production of potatoes are Florida and Texas.

In considering the cultural and irrigation practices it has been the effort to make the information applicable to all the States mentioned. Because of the peculiar soil and irrigation conditions of certain sections of California it has been necessary to give cultural instructions for these sections different from those which apply to the rest of the irrigated districts.

TABLE I.—*Acreage and total and average yield of potatoes from irrigated and nonirrigated land in 1919.*[1]

State.	Irrigated land planted to potatoes.		Production.		Average yield per acre.	
	Area.	Ratio to total for State.	Total from irrigated land.	Ratio to total for State.	Irrigated land.	Nonirrigated land.
	Acres.	*Per cent.*	*Bushels.*	*Per cent*	*Bushels.*	*Bushels.*
Arizona	1,011	40.4	37,371	21.4	37.0	91.7
California	29,698	46.9	4,502,597	54.8	151.6	110.6
Colorado	50,631	65.5	7,475,618	84.2	147.6	52.4
Idaho	32,044	74.2	5,409,108	85.8	168.8	80.0
Montana	4,903	22.1	568,008	34.2	115.8	63.2
Nebraska	6,671	7.1	720,883	16.2	108.1	42.6
Nevada	2,823	77.6	410,001	83.5	145.2	98.9
New Mexico	504	16.4	19,650	17.7	39.0	35.5
Oregon	1,880	4.7	181,986	5.1	96.8	87.9
South Dakota	413	.7	35,065	1.2	84.9	49.0
Utah	10,758	89.3	1,559,386	94.6	145.0	69.1
Washington	8,186	14.8	1,526,353	26.0	186.4	92.4
Wyoming	4,532	38.4	532,511	62.6	117.5	43.9

[1] Data from the 1920 Census Report based on the 1919 crop.

SUITABLE SOILS.

A sandy or gravelly loam soil is generally regarded as most suitable for the production of large yields of potatoes of good quality. Fairly good crops may, however, be produced on almost any type of soil except shifting sand or a heavy, sticky clay or adobe, provided the soil is well drained and possesses the required amount of plant food and moisture, coupled with sufficient organic matter to make it reasonably friable.

PREPARATION OF THE SOIL.

Broadly speaking, if the best results are to be obtained, the preparation of the land for a crop of potatoes should begin several years before the crop is actually grown. In order to bring the land up to its highest crop-producing capacity, this preparation should include a definite system of crop rotation combined with a judicious use of barnyard manure. In most of the irrigated sections of the West the rotation crop best adapted to this purpose is alfalfa. In a few localities red clover may be equally satisfactory, and it possesses the advantage over alfalfa of permitting a shorter crop rotation; but where it is possible to grow alfalfa successfully this crop should usually have the preference over clover. This is particularly true on land that is rather heavy or that is underlain with a more or less impervious subsoil, because of its deeper root penetration; however, on lighter soils provided with good subsoil drainage deep root penetration is not of such prime importance.

FALL OR SPRING PLOWING.

Where there is no danger from soil erosion during the winter, the land should be plowed in the fall, as the freezing and thawing during the winter disintegrate the exposed soil, putting it into a fine mechanical condition for the seed bed. The surface should be left loose and rough until spring, so that it will hold the snows and facilitate the penetration of rains.

Where alfalfa sod is to be turned under for a potato crop it is desirable to plow the land twice, in order to thoroughly destroy the alfalfa plants. The first plowing, which is technically known as crowning, should be made as shallow as possible—3 to 4 inches—while the last should be at least 8 inches in depth. When the period between the two plowings is comparatively short, the killing of the alfalfa crowns may be greatly facilitated by frequent disking or harrowing with a smoothing harrow the teeth of which are set rather straight. Disking or harrowing the freshly upturned crowns of alfalfa is an efficient method of destroying the plants, thereby avoiding much unnecessary work the following season in ridding the potato field of volunteer alfalfa plants.

When the plowing is deferred until spring the plow should be followed within a few hours by the harrow in order to pulverize the soil before clods are formed and the surface becomes dry and hard. Fall-plowed land should be disked and harrowed as early in the spring as may be necessary to conserve the soil moisture. If the preparation of the land has been completed some time before planting, the land should be harrowed at frequent intervals up to the date of planting in order to keep it in good mechanical condition and, what is still more important, to conserve the moisture that is stored up in the soil.

VARIETIES.

Experience has demonstrated that comparatively few varieties are adapted to any particular section. The grower should determine which variety or varieties do best on his farm and should confine his efforts to them. Usually it is not considered good practice to grow more than one early and one late variety unless there is some particular market requirement or a special reason for so doing. The Early Ohio is grown most extensively in Colorado for early consumption, while for the main crop the Pearl and Rural New Yorker No. 2 are grown almost exclusively in the Greeley district, whereas on the western slope of the Rockies the Russet Burbank and the Peachblow are the leading varieties.

In Idaho the Early Ohio and the Irish Cobbler are the leading early varieties, while the Russet Burbank (Netted Gem) and the Idaho Rural constitute the two leading late varieties.

In the Stockton district in California the Burbank is the leading potato.

SEED.

The importance of good seed can scarcely be overemphasized, as it is impossible to grow a maximum crop of potatoes if poor or even average seed stock is used. Good seed should be true to name and type and free from mixture and disease. (See the illustration on the title-page. This plate of potatoes consists of selected tubers weighing from 2½ to 3 ounces each.) If scab or Rhizoctonia is present, or if the seed comes from a section where black-leg is prevalent, the tubers should be disinfected before planting.[1]

WHOLE SEED COMPARED WITH CUT SEED.

The relative merits of whole and cut seed have long been in dispute and have served as the basis of considerable experimentation by many investigators. Where careful data have been taken on well-planned experiments it has been found that almost without exception the larger the seed piece used the larger was the total yield produced and the smaller the percentage of marketable tubers. Hence, the apparent advantage secured by an increased yield has generally been offset by the increased percentage of culls or undersized tubers, for which, with few exceptions, the American potato grower has no profitable outlet. In view of this fact it is the exception rather than the rule to find a grower who makes a practice of planting whole seed.

In the irrigated semiarid regions of the West, whole seed may be more advantageously used than in the humid potato-growing belt of the North and East, because it is possible with an abundance of irrigation water to increase the percentage of marketable potatoes over that which might normally be expected where the moisture conditions were solely dependent on the natural rainfall during the growing period of the crop. The employment of small, whole tubers from 1½ to 3 ounces in weight insures a better stand and affords a greater degree of protection from the invasion of disease organisms than does the cut seed. Whether whole or cut seed is used, the seed piece, or set,[2] should be of sufficient size to furnish enough food to support the young plant until it can absorb its nourishment from the soil. Under adverse conditions, a small set often fails to accomplish this end.

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[1] The treatment considered most efficient consists in immersing the tubers before cutting for 1½ to 2 hours in a solution of one-fourth of a pound of corrosive sublimate to 30 gallons of water. Corrosive sublimate is only slowly soluble in cold water, but will dissolve readily in a small volume of hot water. It is extremely poisonous and should be kept away from live stock. Seed potatoes may also be disinfected by immersing the uncut tubers for the same period in a formaldehyde solution consisting of 1 pint of formalin to 30 gallons of water. This treatment is not as effective against Rhizoctonia as the corrosive-sublimate solution.

[2] The term "set" is here substituted for that of seed piece, partially on account of brevity, but more particularly because it is a well-accepted term in European countries.

CUTTING SEED.

The first step in cutting seed is to remove a thin slice from the stem end of the tuber, for the purpose of determining whether it is infected with Fusarium wilt or some other disease causing a brownish or blackish discoloration of the fibrovascular bundles or of the flesh. All tubers showing such discoloration should be discarded. In cutting seed potatoes it should be the aim of the workman to so divide the tuber as to give blocky sets each of which shall possess at least one strong eye. With medium-sized tubers this is best secured by first slicing the tuber in two lengthwise, making the cut

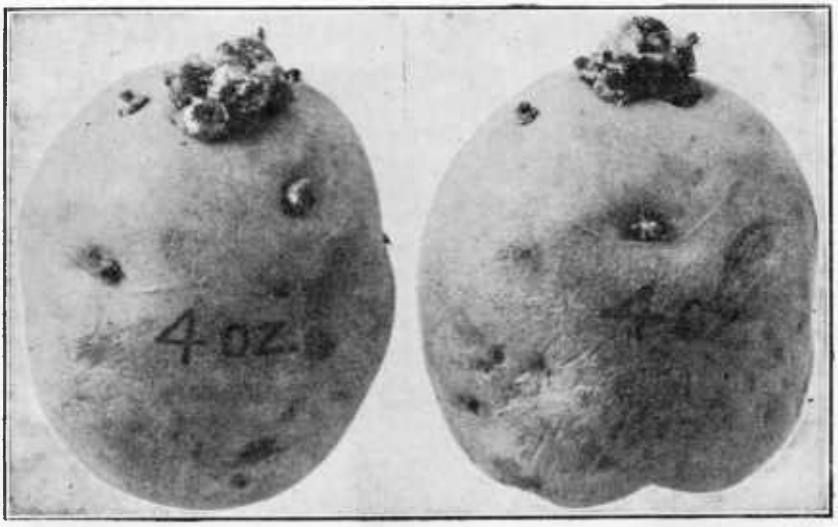

FIG. 1.—Typical 4-ounce seed tubers of the Irish Cobbler variety.

through the bud-eye cluster to the stem end, and then dividing each half in two crosswise. (See figs. 1 and 2.) Sets from $1\frac{1}{4}$ to $1\frac{3}{4}$ ounces in weight if cut as suggested will, if other conditions are favorable, give very satisfactory results. On the basis of a $1\frac{1}{2}$-ounce set, with rows spaced 36 inches apart and the sets 12 inches apart in the row, it will require 1,361 pounds, or about $22\frac{3}{4}$ bushels to plant an acre of land. When it is remembered that the average weight of seed used to plant an acre of potatoes in the United States is less than one-half this amount, it is evident that this is one of the factors which is responsible for the low average production of potatoes in this country—less than 100 bushels—as compared with that of a number of the European countries—over 200 bushels per acre. Economy in the use of seed as a rule is poor policy for the grower to adopt.

CUTTING DEVICES.

Many cutting devices, some of which are automatic, have been developed for the purpose of lessening the labor cost of cutting seed potatoes. Automatic devices for cutting seed potatoes, whether operated by hand or by motive power, are not to be recommended if maximum returns from the crop are to be expected. The automatic cutter does not distinguish between a strong or a weak eye or no eye at all; hence it is quite possible to have, in certain varieties at least, a considerable percentage of eyeless or weak-eyed sets which give an imperfect stand of plants in the field, thereby appreciably

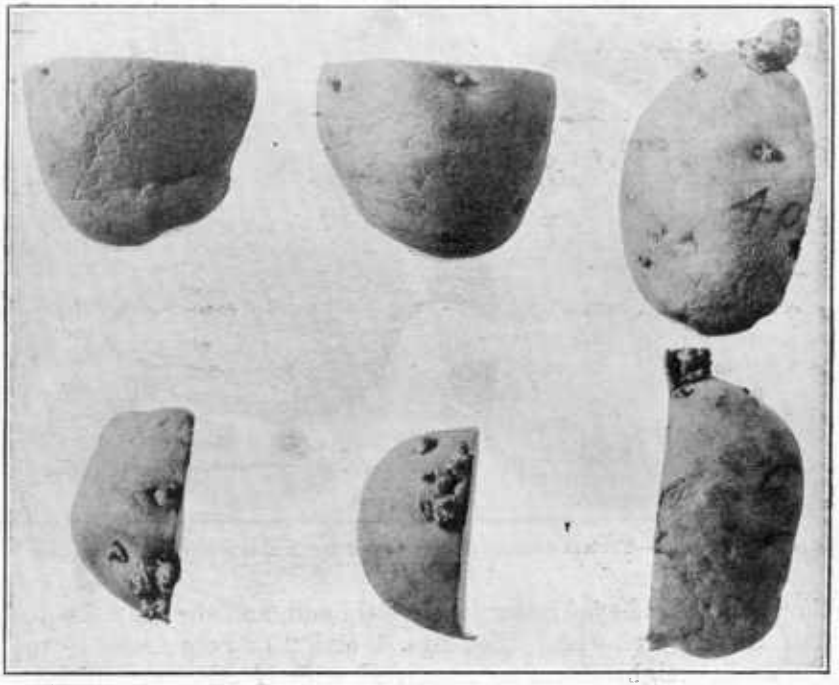

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FIG. 2.—Tubers halved (on the right) and quartered (on the left).

lowering the yield. Automatic cutting machines may be used with a reasonable degree of satisfaction on varieties possessing numerous eyes well distributed over the surface of the tuber. The Early Ohio, Early Rose, and the Burbank are good examples of this class of tubers, while the Irish Cobbler, Rural New Yorker No. 2, and Pearl are good types of varieties on which automatic cutters can not be operated successfully.

A method of cutting which is considered an improvement over the ordinary hand-cutting method is that of fixing a knife in a stationary, upright position on a table, or platform, on which rests a hopper capable of holding one or more sacks of uncut tubers. Two baskets

or sacks are arranged at the edge of the table below the cutter. The knife is usually set with the edge of the blade away from the operator and directly in front of the hopper opening. The operator, after first removing a thin slice from the stem end, divides the tuber in two by clasping it with both hands and pulling it toward him. If the tuber is large enough to make four sets, the second operation divides the two halves horizontally. The sets are allowed to fall into one basket and the waste material into the other. Seated before such a cutting bench an operator can cut a very much larger quantity of seed and with greater ease than where the cutting knife is held in the hand.

CARE OF FRESHLY CUT SEED.

It is a good practice to dust freshly cut seed with flowers of sulphur, land plaster, or air-slaked lime. This can be done most conveniently with a flour sifter as the seed is being cut into the basket or sack. If the cut seed is not intended for immediate planting, it should be spread out in a rather thin layer in a cool place and turned over at least once in 24 hours for a few days in order to avoid any danger from its heating. After the cut surfaces are well healed over, the seed may be sacked up and held until wanted. The grower should be careful not to put disinfected seed into sacks or other receptacles which are infected.

PLANTING.

As a rule, planting should be done as early as conditions will justify, so that the crop will have time to mature fully before killing frosts. On the other hand, planting must be so timed as to avoid all unnecessary risks of having the young plants cut down by late spring frosts. In the potato districts of western Colorado, planting is begun about May 10, while in the Greeley district it is usually delayed until the first of June, in order to escape the early attacks of the flea beetle. In southern Idaho planting is usually done from May 10 to 30, while in the Stockton district of California potato planting may extend from March 10 to June 10, or even later.

In the production of potatoes on a commercial scale it is necessary to hasten the planting operations and reduce their cost by the use of machinery. There are two general types of planters in common use; namely, the so-called "picker," or 1-man planter, and the 2-man planter, of which there are at least two distinct types. In planters of the former type the seed pieces are picked up and dropped at regular intervals by means of spikelike projections called "pickers" attached to a vertical revolving disk. This type of planter has the advantage of dropping the seed automatically, thus requiring but one man, the driver, to operate it. On the other hand, if one of the pickers fails to secure a seed piece during its revolution, a missing

hill results. Furthermore, the pickers may be a source of infection, if disease organisms are present in the seed, as they may transfer the disease from infected to healthy tubers. The hole made in the seed piece by the picker may also furnish a means of entrance for disease organisms which may be present in the soil. With the 2-man type of planter the irregularities of feed are, or should be, adjusted by the extra man who sits on the rear of the machine and takes out or puts in extra seed pieces as occasion requires. With an efficient operator and a steady-moving team the dropping may be perfect.

The distance between the rows may vary from 30 to 42 inches, depending upon the variety, the locality in which the crop is grown, and the relative supply of plant food available in the soil. The usual distances, however, are from 36 to 38 or 40 inches. The distance between the plants in the row can be varied by adjusting the planter to drop close or far apart, according to the nature of the soil, the character of the preceding crop, and the variety to be grown. In some cases planting may be as close as 8 to 10 inches, while in others it may be from 16 to 18 inches. The more common distance is about 12 inches.

Depth of planting is very largely determined by the character of the soil. On light soils it is customary to plant the sets deeper than on heavy soil. Potatoes planted by machine should be placed at least 4 inches below the surface of the ridge, and on rather light soils a depth of 6 inches might be desirable in the irrigated regions.

In the reclaimed delta sections of the Sacramento and San Joaquin Rivers, in California, of which Stockton may be regarded as the center, rather interesting conditions are found. The soil of these reclaimed areas is generally spoken of as tule land. In this bulletin they are considered as peat lands, because for the most part they consist of decaying vegetable matter, varying from 1½ to 20 or more feet in depth. Owing to the peaty character of these lands neither potato planters nor diggers have been successfully operated upon them. Planting in this region therefore is all done by hand. The customary practice is to plant the crop as the land is being plowed. The seed is dropped in the bottom of each alternate furrow and is covered by the next furrow, usually to a depth of 6 to 8 inches. The spacing of the rows varies with different plowmen, but usually ranges from 28 to 32 inches.

If the tule land is plowed in the fall or early winter it must be replowed in the spring in order to plant it.

Some of the better class of growers disk the land before plowing it for planting. It is considered a good practice to harrow or disk the land immediately after it is plowed, in order to conserve soil moisture by filling up the interstices between the furrows.

CULTIVATION.

Cultivation should be started as soon as possible after the potatoes are planted. The main objects to be accomplished by this early cultivation are (1) to loosen the ground, which has become more or less packed between the rows during the planting operations, in order to aerate and improve the physical condition of the soil; (2) to conserve soil moisture by improving its water-holding capacity; and (3) to kill the alfalfa plants that may have survived plowing, where crowning is not practiced, and also to kill all germinating weed seeds.

The type of cultivator most generally used is one that has four shovels about 4 inches wide, so constructed and adjusted that they will throw the soil toward, or even around, the plants. But with the possible exception of fields containing a large number of living volunteer alfalfa plants, it is believed that better results can be obtained by the use of a cultivator having eight narrow shovels, as there is less ridging, less fresh soil brought to the surface to lose its moisture, and the soil is more thoroughly pulverized, thus providing a better soil mulch to prevent the subsequent loss of moisture.

The cultivator should be followed by a smoothing harrow to pulverize the soil before it has had time to dry out and become hardened. The harrowing should be repeated at intervals of about a week until the potatoes are up. The later cultivations are preferably made with a harrow having its teeth set to slant backwards in order to avoid all unnecessary injury to the germinating shoots. After this, the cultivator should be used, but not set so deep as at the first cultivation. Cultivation should cease as soon as the roots of the plants extend far enough toward the center of the row to be seriously injured by the cultivator.

In irrigated peat soils, such as are found in the Stockton district in California, a light harrow serves every purpose for the early cultivations, or until the plants are well above ground. The subsequent care of the crop is much the same as that already described, except that no ridging of the soil is practiced.

IRRIGATION.

Irrigation practices vary considerably in different sections of the West and also in a given community. Different types of soil require different treatments. The customary practice in all irrigated sections of the West outside of the peat lands of the delta of the San Joaquin and Sacramento Rivers, or other sections having similar soil conditions is to run irrigation water through narrow and rather deep irrigating furrows between rows of potatoes. On the peat lands mentioned, water is applied to the crop by means of freshly cut, narrow

irrigation ditches from 24 to 30 inches in depth. These are usually cut between two rows of potatoes and are spaced from 60 to 75 feet apart. These distributing ditches are connected with feed, or supply, ditches, which may receive their supply of water through a head gate or a siphon direct from the river or from a large supply ditch or canal. A large portion of the land is below sea level, as well as below the river level, and when a tract of land has received the necessary quantity of moisture, the water level in the ditch is lowered by means of centrally located pumping stations which pump the water back into the river. The water is distributed through the soil from the lateral ditches by absorption. The peaty character of the soil absorbs and passes the moisture along like a sponge, so that in a relatively short space of time the moisture reaches the center of the 70-foot lands or cuts.

In Colorado, Idaho, and other Western States it is necessary before applying irrigation water to open furrows between each pair of rows or each alternate pair with a ditcher or a cultivator to which shovels are attached. These furrows should be comparatively deep and narrow, so that the water may be applied to the area below the tubers, in which the greater part of the root system is located. It is desirable to keep the irrigation water as low in the furrow as is necessary to prevent its direct contact with the area in which the tubers are developing.

There is considerable diversity of opinion regarding the proper time at which to make the first application of water, some growers contending that it should be withheld until the plants have set their tubers; others say that it is better not to apply water until the leaves of the plants show a decidedly dark blue-green color, which is considered a satisfactory indication of a lack of sufficient moisture; still others claim that the soil should not be irrigated until the foliage begins to wilt. In years of normal winter precipitation, if the land has been properly handled prior to planting the crop, there is sufficient moisture to carry the plants well along to the blooming stage. On the other hand, if winter rains and snows have been light and the ground does not possess sufficient moisture to insure good germination of the seed, it should receive an irrigation prior to the last fitting operation. If it should happen that unusual weather conditions should so sap the moisture from the soil after the crop is planted as to impair the vigor of the seed, the grower should not hesitate to apply water. This is usually called "irrigating up" the crop. Should the weather be very hot and the irrigation water warm, the grower runs some risk from decay of seed pieces by attempting to irrigate up. There is less danger from the application of water under such conditions if the land is irrigated at night.

The more general practice is to apply water whenever the crop appears to require it. If by careful conservation of the soil moisture through proper cultural methods the potato plants can be kept in a thrifty growing condition until the tubers are set, the withholding of water until after that period is probably to be commended. It does not seem possible that any good purpose can be served by delaying the application of water until the plants have begun to wilt.

After irrigation is once begun it should be continued at sufficiently frequent intervals to insure a continuous growth of the plants. If the checking of tuber development at any time during their period of

FIG. 3.—Heavy irrigation of potatoes during their growth. (Photograph from the Reclamation Service.)

growth is followed by a heavy irrigation, prongy or irregularly shaped tubers are almost certain to be produced, particularly with such varieties as the Early Rose, Early Ohio, and those of the Burbank type.

The uniformity of distribution of irrigation water is largely determined by the length of the run, the character of the soil, and the regularity of the irrigation furrow. The length of run is controlled to a large extent by the slope of the land and its character. If the field has but a slight fall or if the soil is loose and open, the run should be much shorter than is necessary when the percentage of grade is sufficient to insure a reasonably rapid movement of water and the soil is of a closer texture. A sufficient head should be turned into each ditch or furrow to carry the water to the lower end in the shortest possible time consistent with the avoidance of any undue washing of the soil. When the water reaches the lower end the head

should be cut down so that a small continuous stream will flow through each furrow. The rate of flow through the furrow may be more or less exactly governed by the use of irrigating tubes 1¼ inches in diameter and about 18 inches long connected with the supply ditch. The water in the supply ditch can be maintained at a given level by the use of board or canvas checks so arranged as effectively to arrest the flow of water in the ditch. The discharge of water through the irrigating tubes may be further controlled by raising or lowering the check boards or gates. For experimental purposes the irrigating tubes furnish a convenient and controllable means of applying a uniform supply of moisture to any given set of plants on which the duty of water is being studied. The practical grower does not, as a rule, use the irrigating tubes, because it is more convenient to turn a heavier stream of water into the irrigating furrows and use his judgment in regulating the flow. (See fig. 3.)

CROP ROTATION.

The crop rotation that is generally practiced on the irrigated farms of the West on which potatoes are grown consists of alfalfa from three to five or more years, followed by two crops of potatoes, after which a crop of grain is grown, generally oats, barley, or wheat, in which alfalfa is sown. In other words, with land in alfalfa five years, two crops of potatoes are grown every eight years, while with land three years in alfalfa, two crops are produced every six years. At two stations now being operated by the United States Department of Agriculture a 4-year rotation is being followed, namely, two years in alfalfa and one each in potatoes and grain. Whether or not it is desirable to take two successive crops of potatoes from the same land is largely dependent on the extent to which the soil is infected with potato parasites. It has been observed that a much larger percentage of diseased plants occurs on land previously devoted to potatoes, and the percentage is still further increased with a third crop. As has been previously suggested, where clovers can be successfully grown and a shorter rotation is desired clover may be substituted for alfalfa in the rotation scheme.

POTATO PESTS.

As a rule, potato pests controllable by spraying are not serious menaces to the crop on the irrigated farms of the West.

INSECT AND EELWORM PARASITES.

The most serious parasites are flea-beetles, the tuber moth, and the nematode. Flea-beetles are partially held in check by thoroughly spraying the plants with a combination arsenical-fungicidal spray consisting of 3 pounds of arsenate of lead to 50 gallons of Bordeaux mixture made from 5 pounds of copper sulphate and 5 pounds of

lime. Flea-beetles are not easily poisoned and are only indifferently repelled by the distastefulness of foliage covered with Bordeaux mixture.

Neither the tuber moth nor the nematode is controlled by arsenical or contact insecticides. The only way in which they can be combated with any degree of success is by systematic crop rotation and the planting of noninfected seed stock; in other words, preventive rather than remedial measures should be employed. Graf,[1] in a recent publication, says:

> The numbers of the insect [tuber moth] should be reduced by practicing good farming and leaving no tubers exposed for the insect to work on. . . . Once the tubers become infested the best way of ending the damage is to fumigate with carbon bisulphid, using 2 pounds to 1,000 cubic feet of air space (measured before storing the tubers) and allowing 48 hours for fumigation.

Fortunately, the tuber moth is not a serious pest outside of certain areas in California, and the nematode is also largely confined to the tuber-moth areas in California and in portions of Nevada. The damage caused by either of these pests is, in the aggregate, relatively insignificant.

FUNGOUS DISEASES.

The principal fungous diseases are those which live over in the soil, such as the Fusarium wilt, Rhizoctonia, and potato scab. The first of these can be successfully held in check only through the rigid rejection of all infected seed tubers when cutting the seed, the removal of infected plants from the seed plat, and by crop rotation. Tubers showing Rhizoctonia sclerotia may be disinfected by immersing the uncut tubers in a corrosive-sublimate solution for 1½ to 2 hours, but as most soils, particularly those which have been in alfalfa, are more or less abundantly infected with Rhizoctonia, the seed treatment may not materially lessen the infection.

Seed tubers infected with scab may be thoroughly disinfected by the corrosive sublimate or the formalin treatment, but here, again, unless they are planted on scab-free land, the treatment may be of little avail.

Early blight may sometimes cause serious loss, but its prevalence is not widespread nor constant in the region now under consideration, and for that reason control measures are not advised.

The late blight, so far as known, does not occur in the irrigated regions of the West.

On the whole, control measures are largely of a sanitary nature, and if due attention be given to crop rotation and to the planting of disease-free seed, little apprehension need be felt regarding undue losses from these sources.

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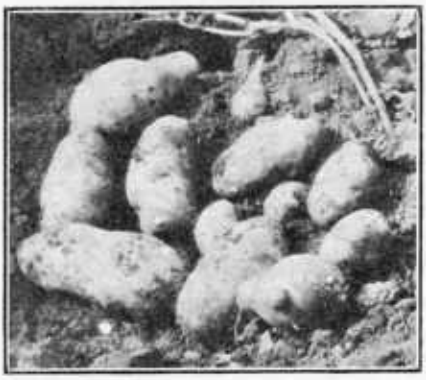
[1] Graf, J. E. The potato tuber moth. U. S. Dept. Agr. Bul. 427, p. 51. 1917.

SEED SELECTION AND THE SEED PLAT.

HILL SELECTION.

If the best results are to be attained in potato production, greater care must be given to the development of high-grade seed potatoes than is the present practice. Wherever the climatic and soil conditions are such as to make it possible to produce a good quality of seed potatoes, each grower should have his own seed plat. In the selection of seed potatoes it should be borne in mind that the hill rather than the individual tuber is the unit. The method which is most certain to lead to improvement is that of hill selection.



H2402HP

FIG. 4.—Yield of tubers from a run-out Russet Burbank plant.

H2398HP

FIG. 5.—The progeny of a normal Russet Burbank plant, showing uniformity of shape and size.

H2393HP

FIG. 6.—Yield from a normal Russet Burbank plant but with a more numerous progeny than that shown in figure 5.

There are various ways of procedure in the practice of hill selection, but the one most likely to give the best results is that of marking the best plants in the field or the seed plat before the foliage begins to ripen and digging them by hand just before harvesting the main crop. The product of each individual plant should be examined separately, and only those that show uniformity in size and shape and that have produced a maximum number of merchantable tubers should be selected. (See figs. 4 to 6.) Each selected hill should be given a number, sacked separately, and a careful record made. The following season the tubers of each selection should be planted separately in order that their behavior may be noted throughout the growing season. It will be found that many of them possess no superiority over the

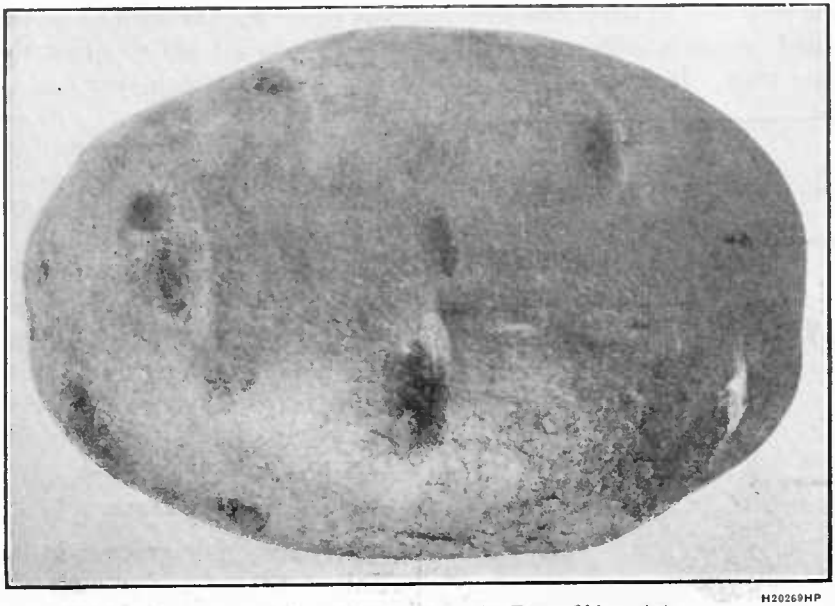


FIG. 7.—A good type specimen of the Early Ohio potato.

general run of field stock, but a few will be decidedly good. A large number of these progeny can be marked for discard before they are harvested. At harvesting time the progeny of each promising selection should again be studied carefully and only those which seem to possess superior merits retained. If it is possible to reduce these to one or two, it is desirable to do so. Further progress along this line consists in increasing the progeny of

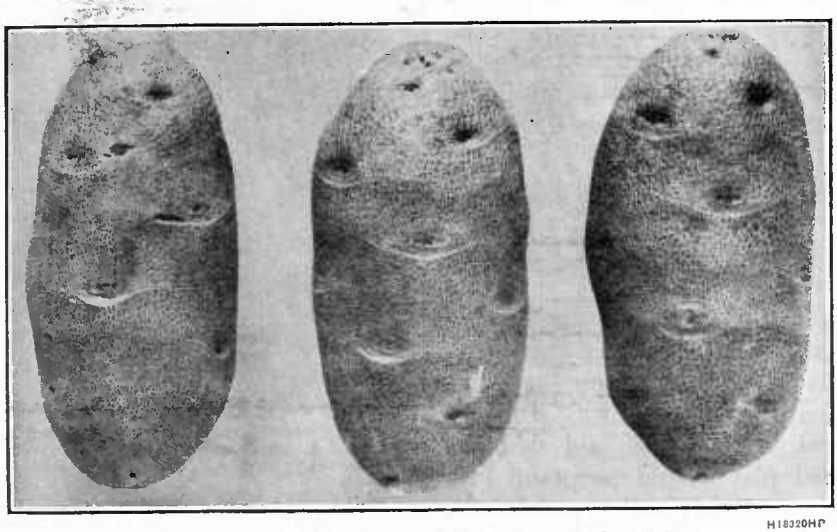


FIG. 8.—Good specimens of the Russet Burbank potato.

the selection or selections as rapidly as possible. At the end of the third season a sufficient quantity should be available to plant the field crop. It is desirable to maintain a seed plat each year and to continue the process of hill selection and the development of pure strains. In order to practice potato selection intelligently it is necessary to have a true conception of the type of the variety or varieties being used. For the guidance of those who are not thoroughly familiar with varieties, type specimens of some of the leading ones are shown in figures 7 to 12.

H20272HP

FIG. 9.—A good specimen of the Rural New Yorker No. 2 potato.

IMMATURE SEED.

Relatively few growers in the United States really maintain a seed plat, and still fewer practice planting the seed plat at a considerably later date than the main crop in order to secure small to medium sized immature tubers, as is the custom with many English and Scotch seedsmen. In planting the seed plat designed for the production of seed for the main crop the following season, it is desirable to plant 2 to 3 ounce whole tubers. (See illustration on the title-page.) The use of whole tubers insures a perfect stand and a minimum percentage of diseased plants. At the same time, as a result of late planting and the heavy set produced by whole seed, the tubers do not attain a large size and are thus ideal for seed purposes. The date of planting the seed plat should be governed by the locality in which the potatoes are to be grown. In general, it might be said that the seed plat should be planted as late as it is possible to insure a good tuber development before the plants are killed by the frost in the autumn.

H14238HP

FIG. 10.—A good specimen of the Pearl potato.

HARVESTING.

Where an early crop is grown, the date of harvesting is largely governed by market conditions. If the price is high, a crop may often be harvested profitably when it is half or two-thirds grown, whereas if prices are low it is generally advisable to allow the tubers to reach full development before they are dug. In the case of late varieties destined for winter consumption it is the usual practice to delay harvesting as long as it is safe to do so without running unnecessary risk of freezing the tubers.

H20273HP

FIG. 11.—A good specimen of the Perfect Peachblow potato.

With few exceptions, the potato crop is harvested with an elevator digger drawn by four horses. (See fig. 13.) When the crop is sold from the field, it is a common practice to sort and sack the potatoes as they are picked up. The sorting or grading of potatoes in the field is most economically done by using a potato grader of the shaker or belt type. These graders are mounted upon a wooden sled and are hauled along by a horse, as shown in figure 14. The sorter has two screens, arranged one above the other. The diameter of the openings in the upper screen in some graders is $1\frac{7}{8}$ inches and in others 2 inches, while the lower one may have openings anywhere from $\frac{1}{2}$ to $1\frac{1}{4}$ inches in diameter. Some makes of graders or sizers have wire-mesh screens with square openings, while others have circular or oblong openings with circular ends. Three pickers usually work with one sorter, each taking a row. The potatoes are picked into wire or splint baskets having a bail handle, and as the baskets are filled they are dumped on the upper part of the top screen and then shaken down. The

H18325HP

FIG. 12.—A good specimen of the Idaho Rural potato.

H830HP

FIG. 13.—Harvesting potatoes in Colorado with a digger drawn by four horses.

large potatoes passing over the top screen are diverted into one sack and those passing through the upper screen and over the lower go into another sack. One man drives the horse and operates the sorter while another sews the sacks and assists in loading the wagons. One digger with the necessary crew of men and teams can harvest from 3 to 4 acres a day.

On the peat lands in the Stockton district in California the potato crop is harvested by hand, the potatoes being picked up by the digger as soon as uncovered.

STORAGE.

The question of storage has, with few exceptions, received greater consideration by potato growers of the West than by those of the East. Nearly every farm is provided with a more or less suitable and serviceable potato storage cellar of a type which is quite distinctive to the West. (See figs. 15 and 16.)

Each year the grower must decide for himself as to the wisdom of storing his crop for winter disposal. Generally it pays to do so, because prices, as a rule, are rather low during the autumn

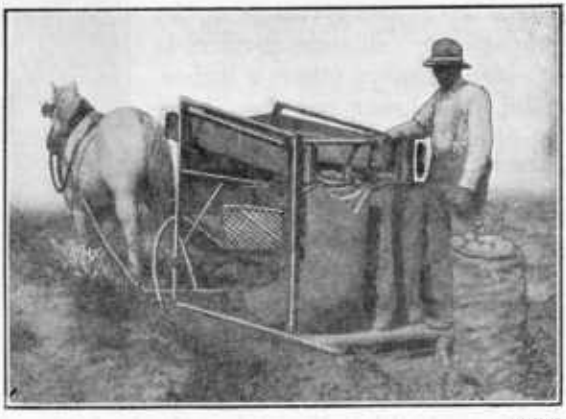


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FIG. 14.—Sorting potatoes in the field as gathered. The potato sorter is mounted on a rough wooden sled hauled by one horse.

months; then, too, the crop can be handled much more quickly when it is stored on the farm as dug than if the grower is obliged to haul it to the shipping station.

It is estimated that on the average about two-thirds of the Colorado potato crop is put into storage.

The potato storage cellars, or "dugouts," as they are frequently called, are usually constructed so that they are partly below the ground level. The walls may be of earth, rough lumber, or concrete. A cheap but substantial storage cellar may be constructed by choosing a knoll and making an excavation from 2 to 4 feet in depth, then setting posts about 6 feet apart along the sides and ends of the

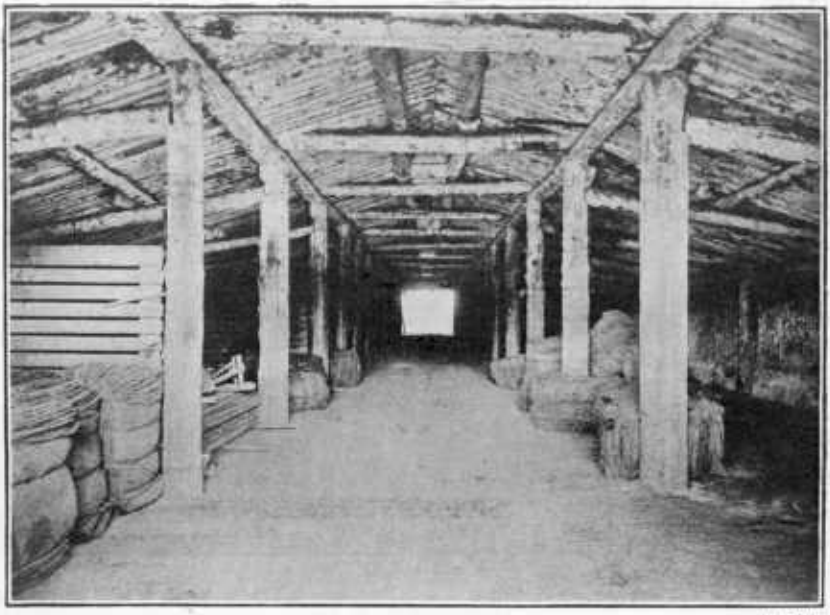

FIG. 15.—A very satisfactory potato storage house. In this particular house advantage has been taken of a narrow ridge. By cutting through it, a ground-level entrance was possible from both ends of the house. Note the earthen side walls.

earthen walls at a sufficient depth to insure their stability and of a length to provide the necessary headroom within the storage cellar. A 2 by 8 or a 2 by 10 plank is spiked to the upper end of the posts for the support of the rafters. The roof pitch may vary from a 16° to a 32° angle.

The rafters may consist of rough poles spaced 12 to 16 inches apart and of sufficient strength to support the roof and its covering of straw and earth. (See fig. 16.) Ample provision for ventilation should be made before the roof is covered. Usually one line of ventilators along the ridge or at one side of it about 10 feet apart and 12 by 12 or 12 by 16 inches in size, provided with caps to exclude rains and snows and further supplied with dampers which may

be closed or opened as desired during cold or moderate weather, furnish ample ventilation. The rafters, as well as the exposed portions of the side and end walls, are covered with heavy woven-wire fence netting, and on this a heavy layer of straw should be spread, which in turn is covered with 6 to 12 inches of soil on the roof and a correspondingly greater thickness on the sides and ends. Entrance to the storage house is usually provided for by a central driveway, the driveway entrance being protected against cold by two sets of doors arranged with a vestibule between, or, where a ground-level entrance is not possible, by a bulkhead entrance.

The interior arrangement usually consists of a series of bins on either side of the driveway.

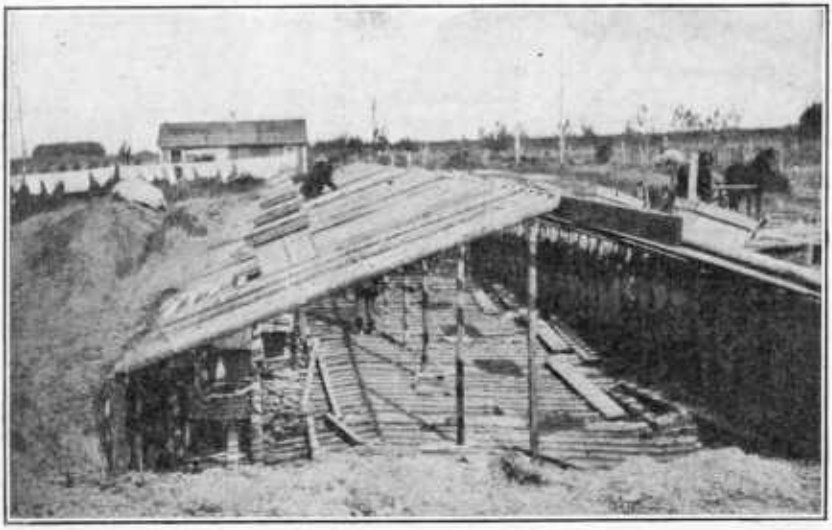

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FIG. 16.—A storage house in process of construction. Note the method used of placing ventilators in the roof.

Successful storage of the potato crop with a minimum amount of shrinkage is dependent to a large extent upon the following factors: (1) The exclusion of all badly cut or unsound tubers, (2) storing the tubers in well-ventilated bins and at a depth (5 to 6 feet) not too great, and (3) careful attention to the regulation of temperature and ventilation and to the exclusion of light. If the storage cellar can be kept at a temperature of 36° to 38° F., it will be sufficient to keep the tubers in a good state of preservation. Under good storage conditions the loss from the evaporation of moisture and from decay should not greatly exceed 5 per cent. The average loss is from 10 to 20 per cent. For further information on storage and storage-house construction, see Farmers' Bulletin 847, entitled "Potato Storage and Storage Houses."

MARKETING.

No fixed rule can be laid down regarding the time when the crop can be marketed to the best advantage. As market conditions are so variable from year to year, prices can not be predicted with any degree of certainty except in seasons when there is a decided shortage in a territory which enters into market competition with another given area. Under such conditions one can be reasonably certain of good prices at some time during the normal marketing period.

Potatoes should be carefully graded before marketing, and all diseased, sunburned, ill-shaped, or badly cut tubers should be removed. In some instances, where cooperative marketing is possible, it may be feasible as well as profitable to go even farther than this by making two or more grades, according to the size of the tubers. If the crop is marketed in sacks, they should be clean, bright, and well filled. Loosely filled sacks present an unattractive appearance, and at the same time the tubers suffer greater mechanical injury through handling.

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